

Listing of claims

1. (original) A method of noncontact dispensing a viscous material onto a surface of a substrate, the method comprising:

providing a jetting valve having a nozzle directing the viscous material flow in a jetting direction nonperpendicular to the surface of the substrate;

causing the jetting valve to propel a flow of the viscous material through the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material using the forward momentum to form a droplet of the viscous material; and

applying the droplet of the viscous material to the surface of the substrate, a wetted area on the substrate produced by the droplet being reduced by the jetting direction being nonperpendicular to the surface of the substrate.

2. (original) The method of claim 1 further comprising:

providing a positioner supporting the jetting valve and being operable to move the jetting valve in a first axis of motion;

moving the jetting valve in the first axis of motion with respect to the substrate; and simultaneously,

iterating the steps of causing, breaking and applying to apply a pattern of the viscous material to the substrate.

3. (original) The method of claim 2 wherein the first axis of motion is a linear axis of motion and the pattern of the viscous material on the substrate is a linear pattern.

4. (original) The method of claim 2 wherein the substrate supports a device having a sidewall separated from the surface of the substrate by a gap, the sidewall being nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the method further comprising:

orienting the jetting direction oblique to the surface of the substrate and intersecting the substrate at a location in or adjacent to the gap;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the gap.

5. (original) The method of claim 2 wherein the viscous material is a conformal coating material and the device has a sidewall nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the method further comprising:

orienting the jetting direction nonperpendicular to the surface of the substrate and intersecting the sidewall of the device;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, breaking and applying to apply a linear pattern of conformal coating material on the sidewall of the device.

6. (original) The method of claim 2 wherein the device has a sidewall nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the method further comprising:

orienting the jetting direction oblique to the surface of the substrate and directed generally toward both the surface of the substrate and the sidewall of the device with a projection of the jetting direction on the surface of the substrate being substantially perpendicular to the sidewall of the component;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the sidewall of the device.

7. (original) The method of claim 4 wherein the sidewall of the device is substantially perpendicular to the surface of the substrate.

8. (original) The method of claim 2 wherein the positioner is operable to move the jetting valve in a second axis of motion nonparallel to the first axis of motion and the substrate has a device mounted thereon with a first sidewall nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the device further having a second sidewall nonparallel to the surface of the substrate and substantially parallel to the second axis of motion, the method further comprising:

orienting the jetting direction oblique to the surface of the substrate and directed generally toward both the surface of the substrate and the sidewall of the device with a projection of the jetting direction on the substrate being oblique to the first and second sidewalls;

moving the jetting valve in the first axis of motion with respect to the substrate;

simultaneously moving the jetting valve and iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the first sidewall of the device;

thereafter, moving the jetting valve in the second axis of motion with respect to the substrate; and while moving the jetting valve in the second axis of motion,

iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the second sidewall of the device.

9. (original) The method of claim 6 wherein the first sidewall and the second sidewall are substantially perpendicular to the surface of the substrate.

10. (original) The method of claim 2 further comprising:

orienting the jetting direction at a first angle with respect to the surface of the substrate;

moving the jetting valve in the first axis of motion with respect to the substrate; while moving the jetting valve,

iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material to the substrate;

orienting the jetting direction at a second angle with respect to the surface of the substrate;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material to the substrate.

11. (original) A method of noncontact dispensing a viscous material onto first and second opposed surfaces of a substrate, the method comprising:

providing a first jetting valve having a first nozzle directing a first viscous material flow in a first jetting direction nonperpendicular to the first surface of the substrate;

causing the first jetting valve to propel a first flow of the viscous material through the first nozzle with a forward momentum in the first jetting direction;

breaking the first flow of the viscous material using the forward momentum to form a first droplet of the viscous material;

applying the first droplet of the viscous material to the first surface of the substrate;

providing a second jetting valve having a second nozzle directing a second viscous material flow in a second jetting direction nonperpendicular to the second surface of the substrate;

causing the second jetting valve to propel a second flow of the viscous material through the second nozzle with a forward momentum in the second jetting direction;

breaking the second flow of the viscous material using the forward momentum to form a second droplet of the viscous material; and

applying the second droplet of the viscous material to the second surface of the substrate.

12. (original) The method of claim 11 wherein the steps of causing the first jetting valve and causing the second jetting valve occur substantially simultaneously.

13. (original) A method of noncontact dispensing a conformal coating material onto a device supported on a surface of a substrate, the method comprising:

providing a jetting valve having a nozzle directing the conformal coating material flow in a jetting direction nonperpendicular to the surface of the substrate and directed toward the device;

causing the jetting valve to propel a flow of the conformal coating material through the nozzle with a forward momentum in the jetting direction;

breaking the flow of the conformal coating material using the forward momentum to form a droplet of the viscous material; and

applying the droplet of the conformal material to the device.

14. (original) A method of noncontact dispensing a viscous material onto a surface of a substrate having a device mounted thereon with first and second sidewalls being nonparallel with the surface of the substrate, the method comprising:

providing a positioner supporting a jetting valve having a nozzle directing a viscous material flow in a jetting direction, the positioner being operable to move the jetting valve along X, Y and Z axes of motion, the X and Y axes of motion being substantially parallel to the respective first and second sidewalls, the jetting valve being pivotable in a first angular axis of motion rotatable about the Z axis of motion and a second angular axis of motion rotatable about one of the X and Y axes of motion;

orienting the jetting direction oblique to the surface of the substrate and intersecting the substrate at a location adjacent the first sidewall with a projection of the jetting direction on the substrate being oblique to the first and second sidewalls;

moving the jetting valve along the X axis of motion; and while moving the jetting valve in the X axis of motion,

creating droplets of viscous material by iteratively

causing the jetting valve to propel a flow of the viscous material through the nozzle with a forward momentum in the jetting direction,

breaking the flow of the viscous material using the forward momentum to form a droplet of the viscous material, and

applying the droplet of the viscous material to the surface of the substrate adjacent the first sidewall, a wetted area on the substrate produced by the droplet being reduced by the jetting direction being oblique to the substrate.

15. (original) The method of claim 14 further comprising:

moving the jetting valve along the Y axis of motion; and while moving the jetting valve along the Y axis of motion,

creating droplets of viscous material by iteratively

causing the jetting valve to propel a flow of the viscous material through the nozzle with a forward momentum in the jetting direction,

breaking the flow of the viscous material using the forward momentum to form a droplet of the viscous material, and

applying the droplet of the viscous material to the surface of the substrate adjacent the first sidewall.

16. (original) A method of noncontact dispensing a viscous material onto a surface of a substrate comprising:

providing a positioner supporting the jetting valve having a nozzle directing a flow of viscous material flow in a jetting direction, the positioner being operable to move the jetting valve in a first axis of motion, and the jetting valve being pivotable on the positioner;

pivoting the jetting valve to orient the jetting direction nonperpendicular to the surface of the substrate;

causing the jetting valve to propel a flow of the viscous material through the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material using the forward momentum to form a viscous material droplet; and

applying the viscous material droplet to the surface of the substrate, a wetted area on the substrate produced by the viscous material droplet being reduced by the jetting direction being nonperpendicular to the substrate.

17. (original) The method of claim 16 wherein the first axis of motion is a linear axis of motion and the jetting valve is pivotable about an angular axis of motion rotatable about the first axis of motion.

18. (currently amended) A method of noncontact dispensing a viscous material onto a surface of a substrate comprising:

providing a jetting valve having a nozzle with an angled exit passage directing the material flow in a jetting direction nonperpendicular to the substrate without having to pivot the nozzle;

causing the jetting valve to propel a flow of viscous material through the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material using the forward momentum to form a viscous material droplet; and

applying the viscous material droplet to the surface of the substrate using the forward momentum of the viscous material droplet, a wetted area on the substrate produced by the viscous material droplet being reduced by the jetting direction being nonperpendicular to the substrate.

19. (original) A method of noncontact dispensing a viscous material onto a surface of a substrate comprising:

providing a jetting valve having a nozzle directing the material flow in a jetting direction;

rotating the nozzle to orient the jetting direction of the material flow nonperpendicular to the substrate;

causing the jetting valve to propel a flow of viscous material through the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material using the forward momentum to form a viscous material droplet; and

applying a viscous material droplet to the surface of the substrate, a wetted area on the substrate produced by the viscous material droplet being reduced by the jetting direction being oblique to the substrate.